NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research & Engineering
Washington, D.C. 20594

August 29, 2006

Fire & Explosion Group Factual

A. ACCIDENT

Accident Number:	DCA06MF016
Operator:	Massachusetts Baylines
Location:	Boston Harbor
Date:	June 12, 2006
Time:	Approximately 4:15 pm
Vessel ID #:	927011

B. FIRE GROUP

Joseph Panagiotou
Fire Group Chairman
National Transportation Safety Board
Washington, D.C.

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Fire Group Member
United States Coast Guard, Boston MA

C. SUMMARY

On Monday, June 12, 2006 at 1600, the M/V *Massachusetts*, a U.S. Small Passenger Vessel carrying 65 passengers and 4 crewmembers, departed Rowe's Wharf in Boston for its first scheduled afternoon commuter ferry run to Hingham, Massachusetts.

At approximately 1620, in the vicinity of Long Island Bridge, a fire was detected in the engine room. The master maneuvered the vessel into shallow water south of the bridge, anchored, and called for assistance. The master hailed the M/V *Laura*, another commuter vessel in the vicinity, and safely transferred all passengers to that vessel. A Boston Fire Department fireboat was dispatched to the scene, and subsequently extinguished the fire. There were no injuries or fatalities caused by the accident.

The fire's damage was contained to the engine space. Preliminary estimates of the fire's damage are $800,000.

D. DETAILS OF THE INVESTIGATION

Examination of the vessel

Exterior

Figure 1: Starboard side of the Massachusetts

The exterior of the vessel did not show signs of any fire damage with the exception of soot stains. These stains were located on the forward and aft grills of the ventilation openings on both sides of the ship (Figure 1). These stains also extended to the areas above and slightly to the sides of the openings. The starboard side was more heavily soot stained than the port side. The forward vents which facilitate the air intake to the engine room appeared to have less soot markings around them as compared to the aft vents which provided the exhaust path for the engine room ventilation. With the exception of the soot markings and a few broken windows[1] the vessel did not sustain significant damage to its exterior from the engine room fire.

Interior

The interior of the main deck did not show signs of fire damage, with the exception of a spot on the floor where the carpet was charred (Figure 2). This location where the carpet was charred on the floor was adjacent to the casing of the forward vent stack to the engine room on the port side of the vessel. There was also a light dusting of soot covering some surfaces on the main and upper decks. There were some broken windows which occurred during the fire fighting efforts.

[1] The fire department broke windows to vent the smoke during the fire fighting efforts. See survival factors report for a description of the firefighting activities.

Figure 2: Charred carpet on main deck, adjacent to vent stack

Engine Room

A diagram depicting the layout of the engine room can be seen in Figure 3. The engine room contained four 12v71 series Detroit diesel engines for propulsion. Each engine had a turbo on each of its sides. There were also two 30kW, 3V71 series Detroit diesel generators, four battery banks and associated electrical control panels and a transformer located within. The hydraulic pumps and reservoir for the steering system were also located in the engine room. Additionally there was a water heater and air compressor located in the engine room. There was a main fuel distribution system delivering fuel from the two tanks to the four engines and two engine generators. This distribution system was a fixed installation and was made out of steel pipe on the supply side and copper tubing on the return. These fuel lines were all traced and found to be intact with no sign of damage.

Overall there was significantly more fire/thermal damage in the forward areas of the engine room than at the rear. All light fixtures and cables running along the ceiling throughout the engine room were severely melted. In general the top surfaces of all components in the engine room had been subjected to substantial thermal exposure. The ceiling of the engine room as well as the bulkheads was lined with thermal insulation. This insulation remained undamaged except in the areas near the forward vents and on the hatch above the port inboard engine, where the face sheet of the insulation was missing. The face sheet appeared to have become brittle and cracked away. The insulation behind the missing face sheets had taken on a grey/black color. The original color was beige.

Engines & Generators

Each of the engines and generators was individually inspected to determine the integrity of the fuel lines, oil lines, exhaust system insulation, turbo chargers and their lubrication systems as well as the overall degree of damage sustained by the fire. The outboard

engines were mounted approximately two feet higher than the inboard engines. The engines utilized an external oil filtration system in addition to the standard oil filters mounted to the engine block. This system required that oil lines run from the engine to a filter mounted on the bulkhead and then back to the engine along the floor of the engine room. Each engine had its own external filter. The findings of the examination are listed below for each engine and generator.

Starboard Outboard Engine

The supply and return lines for the lubrication system of the inboard turbo were found to be intact. The supply and return lines for the lubrication system of the outboard turbo were also found to be intact. The fuel lines from supply to return were found to be intact. The bowl portion of the fuel filter was found to be deformed and appeared to have a slow leak, as witnessed by a small accumulation of diesel in the heat shield underneath it (Figure 4). The bowl of the fuel filter was made from plastic. The oil lines to and from the external oil filtration system (located on the starboard bulkhead) were intact. The oil level in the sump was measured to be normal[2] according to the reading obtained from the dip stick. There was evidence of thermal damage to the top and mid section of the engine in the form of burnt through coolant lines (water is used as the coolant) and wires that had melted insulation. The paint on the exhaust and engine block was undamaged. The thermal lagging on the exhaust was intact. Overall the damage indicates that the engine sustained a thermal exposure from the top down.

Starboard Inboard Engine

The supply and return lines for the lubrication system of the inboard turbo were found to be intact. The supply and return lines for the lubrication system of the outboard turbo were also found to be intact. The thermal lagging on the turbo chargers and exhaust was intact. The fuel lines from supply to return were found to be intact. The bowl portion of the fuel filter was found to be intact. The oil lines to and from the external oil treatment system (located on the starboard bulkhead) were intact. The oil level in the sump was normal as measured from the dipstick. There was evidence of thermal damage to the top section of the engine in the form of burnt through coolant lines (water is used as the coolant) and wires that had melted insulation. The paint on the exhaust and engine block was undamaged. The water strainer aft of the engine showed thermal damage[3] in a section facing the rear of the port inboard engine (Figure 5).

[2] Within the safe operating range indicated on the demarcations of the dip stick.
[3] The thermal damage was characterized by small bubbles and blistering of the plastic material causing a white appearance.

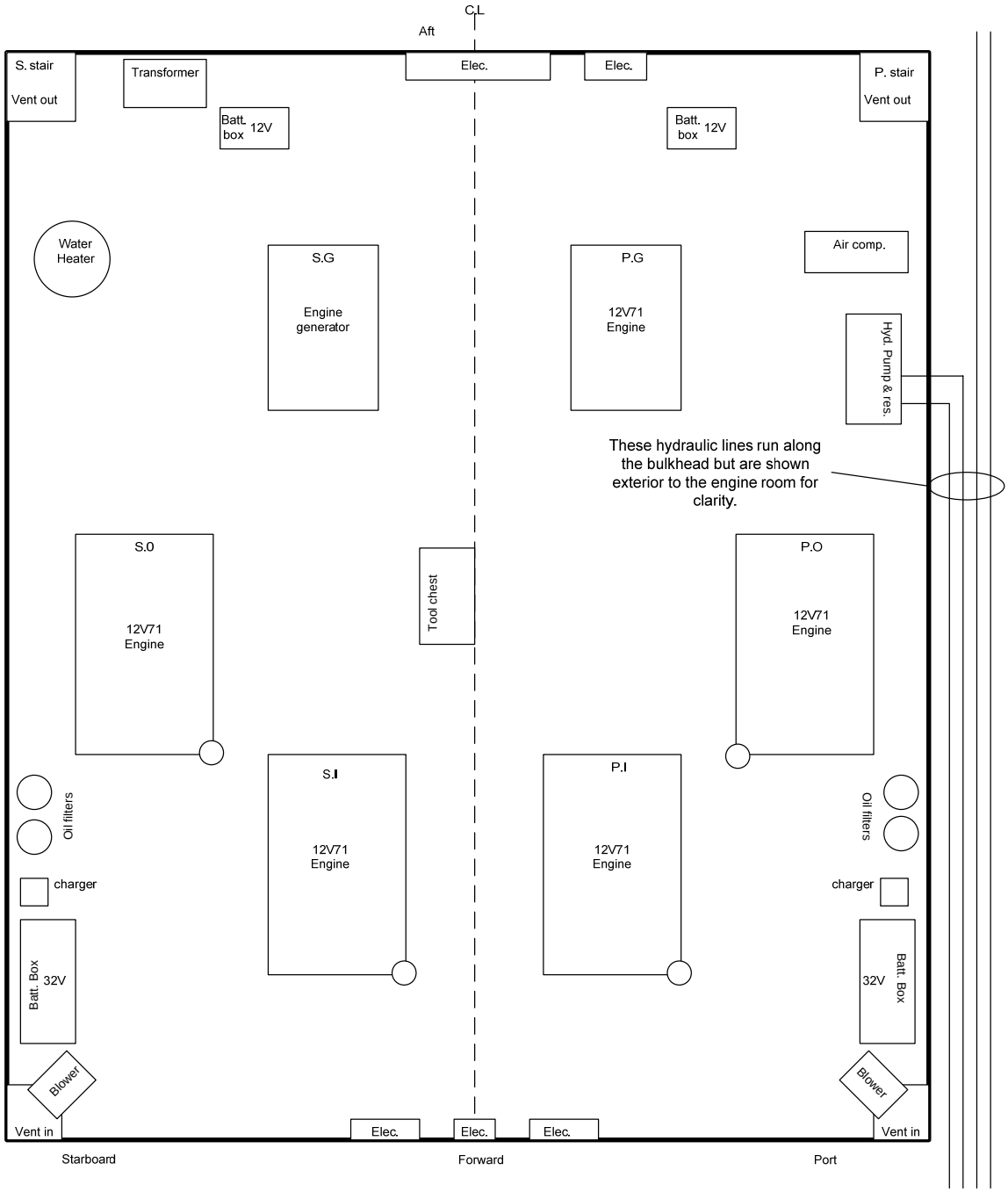

Figure 3: Sketch of engine room layout. (Not to scale)

Figure 4: Plastic bowl of fuel filter on Starboard outboard engine

Figure 5: Water strainer behind Starboard inboard engine

Port Outboard Engine

The supply and return lines for the lubrication system of the inboard turbo were found to be intact. The supply and return lines for the lubrication system of the outboard turbo were also found to be intact. The thermal lagging on the turbo chargers and exhaust was intact. The fuel lines from supply to return were found to be intact. The bowl portion of the fuel filter was missing. The oil lines to and from the external oil treatment system (located on the port bulkhead) were intact. The oil level in the sump was normal as measured from the dipstick. There was evidence of thermal damage to the top and forward sections of the engine in the form of burnt through coolant lines (water is used as the coolant) and wires that had melted insulation. The paint on the exhaust and engine block was undamaged.

Port Inboard Engine

The supply and return lines for the lubrication system of the inboard turbo were found to be connected at both ends but having sustained significant thermal damage[4]. The supply and return lines for the lubrication system of the outboard turbo were also found to be connected at both ends and exhibiting substantial thermal damage. Specifically these lines had become brittle and the rubber portion had melted away leaving the armor behind. The fuel line from the supply to the fuel filter was intact. The bowl portion of the fuel filter was missing. The fuel line to the fuel cooler was severed at the fitting (Figure 7). This fuel line was brittle with just the armor remaining. The oil return line from the external oil treatment system (located on the port bulkhead) was severed[5] at a location below the port inboard engine. There was a missing oil line on the inboard side of the engine block (Figure 6). There was no oil left in the sump as determined by checking with the dipstick. There was extensive thermal damage to the entire engine in the form of burnt through coolant lines (water is used as the coolant), wires that had melted insulation leaving behind bare conductors and missing paint. The transmission lubrication lines which were rubber coated armored lines were intact but had lost their rubber coating and had become brittle from thermal exposure. The valve cover on the inboard side was significantly deformed towards the aft section and it had taken on a white oxidized appearance (Figure 8). The valve cover gasket was sticking out from under the valve cover along the inboard aft section. Upon removal of the inboard valve cover it was found that a fuel jumper line associated with the third cylinder from the front was disconnected and sitting above the mating surface below (Figure 9). The air intake manifold downstream of the turbo showed signs of severe heating. Specifically it had taken on a heavily oxidized appearance and exhibited areas of deformation and sagging. The paint on the exhaust and engine block was burnt away with the exception of a few areas in the front of the engine. The water strainer aft of the engine was melted along the surface facing forward, towards the port inboard engine (Figure 10). The inboard engine mounting rail was slightly bent inboard and showed signs of cracking along weld seams towards the aft section (Figure 16). The paint on the secondary fuel filter was burnt off along the portion facing towards the rear of the engine and intact along the portion facing towards the front. After removing the air intake filter from the inboard turbo it was found that the compressor blades were severely damaged exhibiting a ragged edge appearance (Figure 11).

[4] These were armored lines with a rubber coating which had been burnt off leaving the armor behind. The lines had become brittle and would crack if moved.

[5] The oil line appeared to have been burnt through and was completely separated.

Figure 6: Missing oil line on lower inboard side of the port inboard engine block

Figure 7: Fuel line to fuel cooler severed at fitting

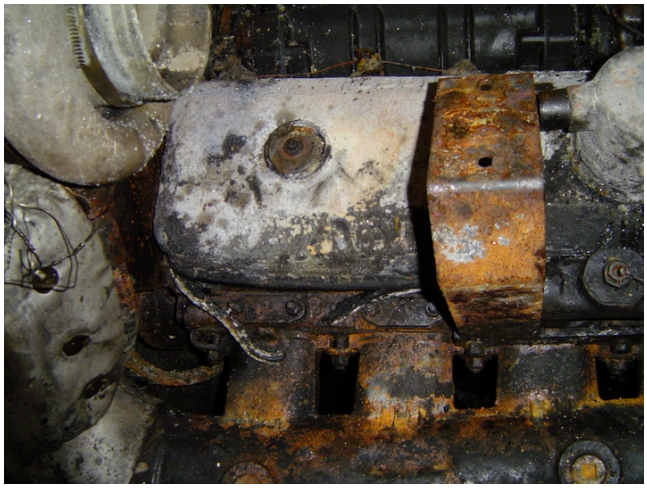

Figure 8: Port inboard engine, inboard valve cover

Figure 9: Number 3 cylinder fuel jumper line of port inboard engine, inboard side

Figure 10: Water strainer aft of port inboard engine

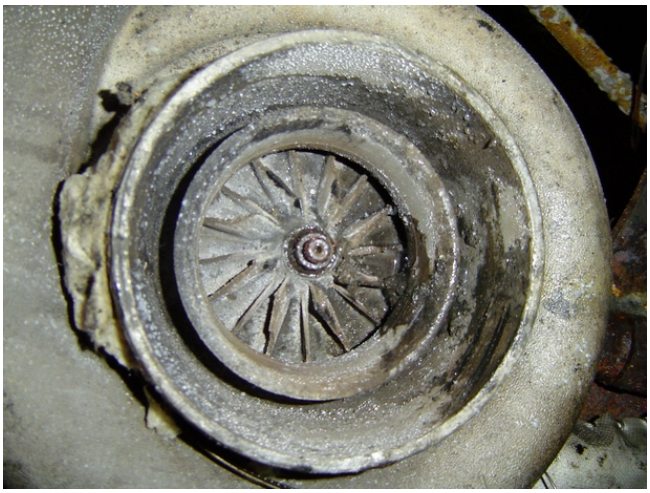

Figure 11: Port inboard engine inboard turbo compressor blades

Starboard Generator

The fuel supply and return lines were intact. The fuel filter's bowl was intact. The oil lines were intact and the oil level in the sump was normal as measured using the dipstick. The coolant lines at the top of the engine were burnt through. The face plates of the gauges at the top of the engine were melted. The paint on the engine block was intact as well as the engine's wiring. The damage sustained by this engine generator indicated heating from above.

Port Generator

The fuel supply and return lines were intact. The fuel filter's bowl was intact. The oil lines were intact and the oil level in the sump was normal as measured using the dipstick. The coolant lines at the top of the engine were burnt through. The face plates of the gauges at the top of the engine were melted. The paint on the engine block was intact as well as the engine's wiring. The damage sustained by this engine generator indicated heating from above.

Hydraulic Steering System

The pumps and reservoir for the hydraulic steering system were located in the engine room towards the rear of the port side. Two electrically driven hydraulic pumps were located above the reservoir. Two stainless steel lines ran from the pumps forward, through the engine compartment along the port side bulkhead and ended up at the pilot house. Two more stainless steel lines ran from the pilot house through the engine room along the port side bulkhead and ended up at the steering ram at the rear of the vessel. None of the four hydraulic lines showed any signs of damage or leaks. The hydraulic reservoir was found to be full of hydraulic fluid.

Engine Room Ventilation

The engine room ventilation system consisted of two air intake vents on either side of the forward bulkhead and two exhaust vents at the rear. The rear vents were coincident with the stair wells, and were natural ventilation. The forward intake vents consisted of an aluminum duct with a cylindrical, electrically driven blower attached (Figure 13). On the port side, the aluminum duct had melted (Figure 12) and the blower was found on the floor below. On the starboard side the intake vent and blower were intact.

Figure 12: Port side air intake duct

Figure 13: Starboard side air intake duct and blower

Battery Banks

There were four battery banks found in the engine room. Two 12V banks along the rear bulkhead of the engine room on the port and starboard sides. These battery banks were used to start the generators and power the compass light, depth finder, VHF, 12V horn and 7 emergency lights. The plastic boxes which contained these battery banks showed signs of melting and sagging along their top surfaces, but no significant damage along the sides. As far as could be determined, without prying the melted covers off, the batteries inside the boxes were intact.

Two 32V battery banks were located in the forward section of the engine room on the port and starboard sides. They were contained within wooden boxes. These battery banks were used to start the 4 main engines, the engine room lights, the radar and the trim tabs. The wooden box containing the starboard side battery bank appeared to be burnt on the top surface only. The top surface was completely consumed and the tops of the batteries

were damaged. The wooden box containing the port side battery bank appeared to have been burnt from all sides from the outside inwards. The paint on the inside surfaces of this battery box was intact. On the top surface there were some non charred areas that had been protected by pieces of wood which had been placed on top of the battery box some time prior to the accident. The batteries in the interior of this box appeared intact.
The cables to and from these battery banks had sustained significant thermal damage in some regions along their runs resulting in the loss of their insulation. There was no evidence of arcing against conductive surfaces or between the conductors themselves found any ware along their lengths.

Structural damage to the engine room

There were some areas with structural damage in the engine room. This damage was characterized by melted and sagging aluminum members and was more extensive in the areas above the port inboard engine and at the location of the fresh air intake vent on the port side of the engine room (Figure 12). There also was damage to the floor decking and the support structure below, inboard and aft of the port inboard engine (Figure 15). Above and to the outboard side of the port inboard engine there were melted and sagging aluminum components (Figure 14). These components consisted of ~1/4" thick by 2" wide bars spanning the length of the ceiling. There was a vertical aluminum column spanning from the floor to the ceiling which had softened, fractured, and bent out of alignment in this area also (Figure 14). Along the centerline of the engine room towards the rear of the port inboard engine there was a hole melted through the floor decking. Upon moving the decking it was found that the structure supporting the decking had also melted and severed and in some areas was sagging (Figure 15). Also the inboard engine mount which consisted of an aluminum rail had some cracks along the welds (Figure 16). A diagram showing the locations of the most pronounced fire damage to the vessel's structure and machinery can be seen in Figure 17.

Figure 14: Melted and deformed aluminum members in area above port inboard engine

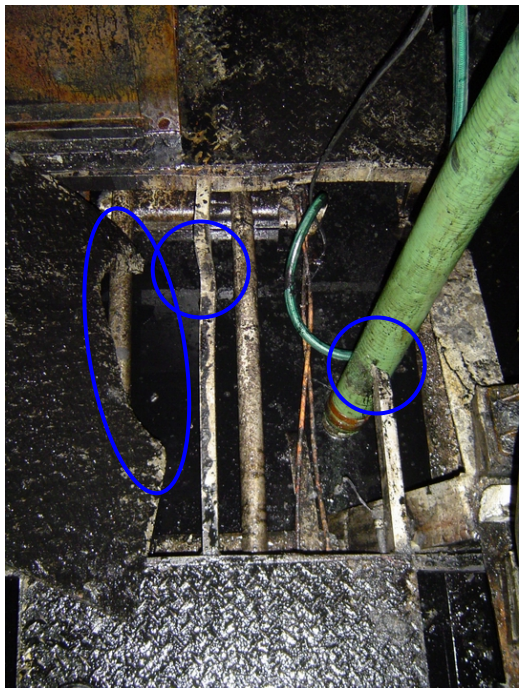

Figure 15: Melted and deformed floor supports and decking

Figure 16: Cracked welds on engine mounting rail of port inboard engine

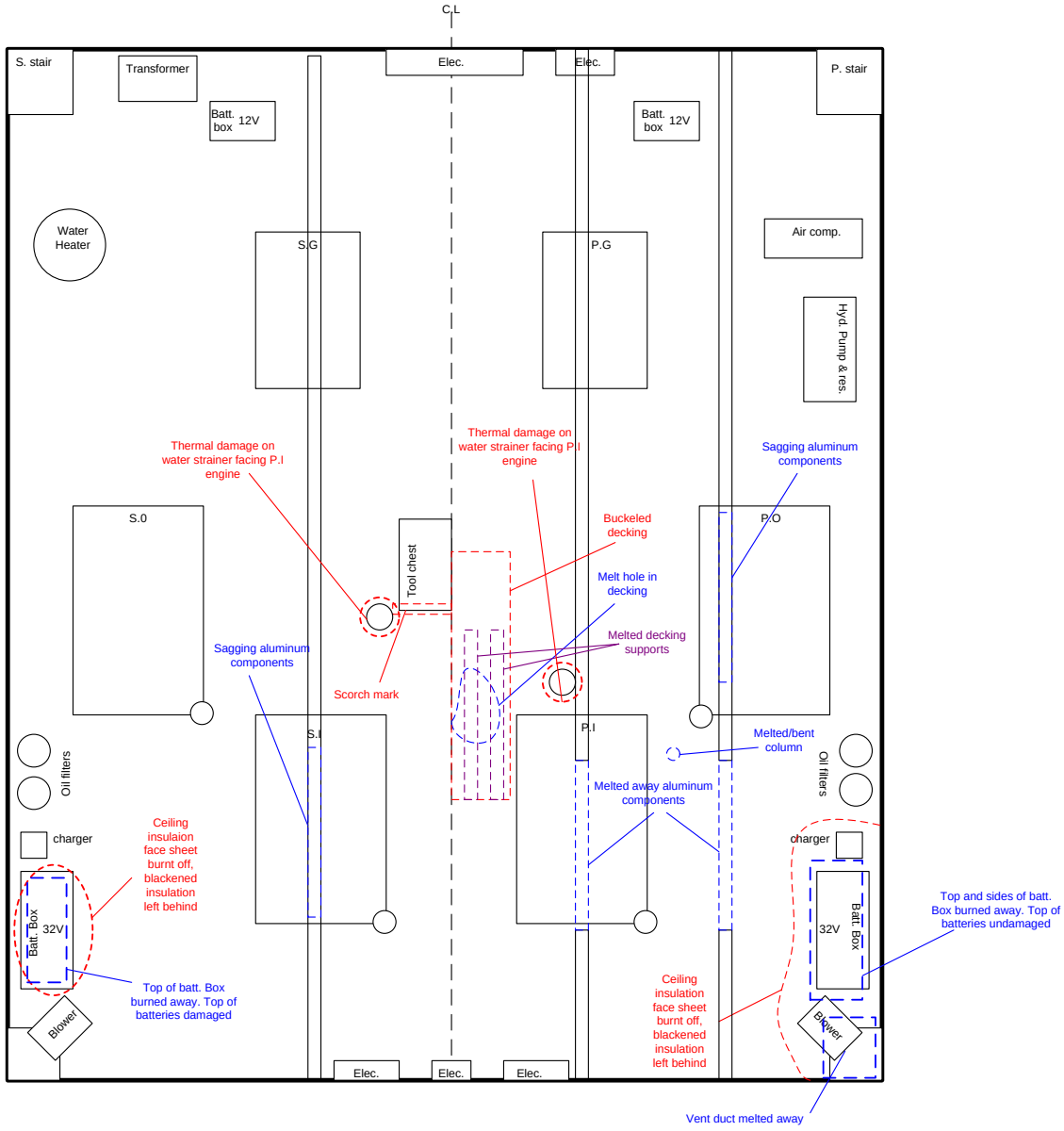

Figure 17: Diagram of most severe fire damage (Not to scale)

Fire Detection & Suppression Systems

No fire detection or suppression systems were present in the engine room. This vessel was a K-Boat built in 1988 and there were no requirements to have detection or suppression.

Components Removed and Sent to NTSB Materials Laboratory

Certain items were removed and retained for further examination at the NTSB materials laboratory in Washington, D.C.
Below is a table listing these components in no particular order.

Item #	Description
1	Right bank turbo charger from port inboard engine
2	Right bank valve cover from port inboard engine
3	Inboard side air manifold from port inboard engine
4	Right bank valve cover gasket
5	Supply fuel line from right bank port inboard engine, 3rd cylinder from the front
6	Return fuel line from right bank port inboard engine, 3rd cylinder from the front
7	Oil Sample from the port inboard engine's oil filter